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**Civil Engineering**

**ENERGY MANAGEMENT AND  
CONSERVATION**

**COMPLIANCE WITH THIS PUBLICATION IS MANDATORY**

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This instruction implements AFD 23-3, *Energy Management*, and Executive Order 13123 by establishing the responsibilities and procedures for energy management. It applies to all 21<sup>st</sup> Space Wing (21 SW) activities and tenant organizations of the 21 SW. A copy of unit supplements will be sent to 21 CES/CEO. This publication does not apply to the USAF Reserves or the Air National Guard units assigned or to those who have tenant agreements outside the 21 SW. Maintain and dispose of records created as a result of prescribed processes in accordance with AFMAN 37-139, *Records Disposition Schedule*, (will become AFMAN 33-322 Vol 4).

**SUMMARY OF REVISIONS**

**This document is substantially revised and must be completely reviewed.**

This instruction supersedes 21 SW Regulation 18-1 and provides format changes to the Air Force standard of instructions. This instruction is provided to give guidance in energy management to the various activities and sites assigned to 21 SW.

**1. GENERAL:**

1.1. With the ever increasing expense to maintain a good active force structure, an ever increasing need for energy in this technologically advanced society, coupled with decreasing available energy and budgets, it is necessary to reduce consumption and costs to make more funds available for mission-essential requirements. The efficient use and management of unit energy consumption can realize these savings.

1.2. An effective energy management program encompasses three subprograms: Awareness, Consumption, and Conservation.

1.3. As per AFPD 23-3 Para. 9.3: Each level of command (HQ USAF, major command or equivalent, or installation) will establish an Energy Management Steering Group (EMSG) to coordinate all energy matters within the applicable level of command. The 21 SW is a diverse organization, with Peterson Air Force Base as the headquarters location, and numerous Geographically Separated Units (GSUs). Due to this diversity in organization, command and control, and sub-missions, this instruction will be used as guidance and direction and must be tailored to each unit's structure.

1.4. To maintain a completely effective energy management program, involvement and execution is required at all levels.

1.5. This instruction does not alter the reporting requirements as outlined in any other applicable Air Force guidance or instruction.

## 2. OBJECTIVES:

2.1. To meet the energy reduction goals as outlined by Presidential Executive Order Number 13123.

2.2. To use energy with little to no waste. Consume smartly.

2.3. To establish procedures in construction design to provide optimum efficiency in energy consuming equipment. Manage and maintain smartly.

2.4. To use energy only when required. Conserve smartly.

2.5. To ensure all sources of energy consumption are operated and maintained in an efficient and economical manner.

2.6. To document energy and utility consumption to enable complete analysis and achieve the maximum reduction possible in energy consumption.

2.7. To make all 21 SW personnel aware of the importance of energy conservation and encourage participation in programs to maximize energy efficiency and conservation.

## 3. RESPONSIBILITIES:

3.1. General. An effective energy program is the responsibility of all Air Force personnel, but more specific responsibilities are outlined below:

3.2. All commanders will have an active role in energy management and ensure all their personnel take an active part in saving energy. Commanders will ensure compliance with this instruction, with the flexibility to take into account that mission is not compromised, and stress the importance of the individual's role in the program.

3.3. Supervisors at all levels will show their support for energy management and encourage subordinates to take an active role in saving energy.

3.4. Individuals will exercise good judgment when using energy resources to stop waste. All personnel will make corrections on site or alert supervisors when they see resources inefficiently used or wasted. Individuals are encouraged to suggest energy saving technologies and strategies as appropriate through the Innovative Development through Employee Awareness (IDEA) program.

3.5. The 21 SW Commander:

3.5.1. Establishes an Energy Management Steering Group (EMSG) or incorporates functions within existing meeting structures.

3.5.1.1. The 21 SW Commander or designee shall be the chairperson responsible for the following:

3.5.1.1.1. Directs the EMSG in the establishment of energy management plans and programs.

3.5.1.1.2. Assigns projects, studies, and specific tasks to members of the EMSG.

3.5.1.1.3. Assigns member to the EMSG based on the organizational composition of the Installation and the energy consumer composition.

3.5.1.1.4. Approves EMSG recommended projects, studies, and tasks developed by the EMSG with Peterson AFB and 21 CES Site Support Energy Managers.

3.6. 21 SW GSU Commanders:

3.6.1. The GSU Installation Commanders (applies to 4 GSU Installations)

3.6.1.1. Shall assign installation energy managers for each site.

3.6.1.2. Handle the responsibilities and duties assigned to the 21 SW Commander, paragraph **3.5.** except **3.5.1.1.4.**

3.6.2. The GSU Site Commanders (applies to sites that are part of host installation)

3.6.2.1. Follow host energy management plans and programs.

3.7. The 21 CES Commander:

3.7.1. Assigns a 21 SW Energy Manager (EM) with the following duties:

3.7.1.1. Establishes, maintains, and tracks facility energy consumption for energy goals and reporting in accordance with federal, state and local requirements.

3.7.1.2. Consults and determines where facility energy usage inefficiencies exist and initiates corrective actions through short and long term plans.

3.7.2. Assigns Peterson AFB and GSU Support energy managers to develop individual unit taskings for coordination within their prospective units.

3.7.3. Is responsible for energy shortage contingency plans and programs. Develops tools for conservation including the following attachments: Facility Manager's Energy Guide (**Attachment 1**), Facility Maintenance Superintendent Energy Audit Guide (**Attachment 2**), and Civil Engineering O&M/ECM Energy Conservation Guide (**Attachment 3**).

3.7.4. Publishes directives for the use of 21 SW utilities.

3.7.5. Is responsible for the updating of information for the Defense Energy Information System (DEIS-II) Facility Energy Report. This is also known as the Defense Utilities Energy Reporting System (DUERS).

3.8. Facility Manager:

3.8.1. Each facility has a facility manager assigned in accordance with 21 SWI 32-901.

3.8.2. Facility Managers will ensure efficient use of utilities. **Attachment 1** Facility Manager's Energy Guide is a tool to identify and address specific energy usage items. Responsibilities include but are not limited to:

3.8.2.1. Eliminating unnecessary lighting.

3.8.2.2. Establishing conservation measures including turning off lights, office equipment and personal computers during unoccupied hours.

3.8.2.3. Encouraging facility users to keep doors and windows shut when air conditioning or heating is on.

3.8.2.4. Working with 21 CES to keep facility temperatures in compliance with current guidelines.

3.8.2.5. Ensuring excessive use of water is curtailed, such as constantly flowing urinals, drinking fountains, leaking shower heads, faucets, and flush valves. In addition, the use of water for washing aircraft, vehicles, etc. is to be minimized. In extremely cold climates mission requirements may override conservation efforts, i.e., Thule AB, water must be kept running to prevent pipe freeze-up.

3.8.2.6. Ensuring refrigerator coils are kept clean to ensure maximum efficiency of the unit.

3.8.2.7. Enforcing wing policy to prohibit use of space heaters and portable air conditioning units except in emergency situations or as deemed necessary by the GSU or 21<sup>st</sup> Civil Engineer Squadron commander. Individual space heaters are also prohibited by fire department policies.

3.8.3. Reporting problems beyond the control of the unit to the supporting Civil Engineer customer service desk.

### 3.9. EMSG (Energy Management Steering Group):

3.9.1. Will meet no less than two times per fiscal year. As a meeting minimum, agenda shall include slides/reports summarizing energy use, problems, and goals. An annual review of current energy programs will be conducted to ensure compliance with directives.

3.9.2. Will maintain meeting minutes.

3.9.3. Will establish committees for specific problem areas.

3.9.4. Will establish specific rules, guidance and procedures for Wing/GSU energy management. Energy supplies, utilities conservation and energy management processes used by the 21 SW include but are not limited to:

3.9.4.1. Electricity

3.9.4.2. Natural Gas

3.9.4.3. Petroleum fueling products for electrical or heating production

3.9.4.4. Water and Wastewater conservation and reuse

3.9.4.5. Energy Management and Control Systems (EMCS)

3.9.4.6. Heating, Ventilation, and Air Conditioning Systems (HVAC)

3.9.4.7. Interior and exterior lighting

3.9.4.8. Temperature controls and ranges

3.9.4.9. Building envelopes

### 3.10. The Unit Energy Management Council (UEMC):

3.10.1. General. Multiple levels of UEMCs may be established based on organizational lines, building usage, functional use, etc. A UEMC is recommended for GSUs and large energy consumer users. If a GSU is a stand-alone installation, it will follow the guidance given for installations and establish an EMSG or its equivalent (based on contract constraints). If the GSU is a tenant of an installation and its energy consumption is reported through the host organization, the GSU should develop a UEMC and follow the guidance, rules, and instructions of the host organization for energy consumption and conservation. The facility manager can be the focal point for this meeting or in the case of specific sub-organizations or tenants, the commander or chief of the activity. Example: the 21 Services Squadron Commander could establish a UEMC for services to disseminate energy, conservation, awareness, and consumption information and strategies.

3.10.2. Will consist of representatives from units or tenants from the building. Their unit commander will assign representatives via an appointment letter. UEMCs will forward council composition and minutes to the base or GSU energy managers. The unit commander or the facility manager will determine the membership of the council.

3.10.3. Encourages energy awareness and helps institute energy management and conservation within their unit.

3.10.4. Develops a unit/facility energy monitor program. Recommend monitors have an item-by-item guide to use in random monitoring of utilities management/energy conservation in their areas of responsibility. See [Attachment 1](#) for a Facility Manager's Energy Guide, which can be modified to include building or mission specific items.

3.10.4.1. The unit/facility energy monitor program will incorporate control and surveillance strategies.

3.10.4.2. Eliminates energy use practices not conducive to meeting energy conservation goals. Recommend alternative goals and/or practices.

3.10.5. Compiles results of program implementations, energy usage and reduction, along with suggestions and ideas dealing with energy management to the base or GSU point of contact.

## 4. ALTERNATIVE ENERGY PROJECT FUNDING SOURCES:

4.1. General. With limited funding the 21 SW cannot fund all of its energy conservation measures and realize the savings immediately and re-invest those savings appropriately. Due to these government funding limitations, pursuit of alternative funding sources is required in order to meet current and future energy reductions.

4.2. The Energy Conservation Investment Program (ECIP) and Federal Energy Management Program (FEMP) are alternative government funding streams. Project submittals are similar to 1391 processes for MILCON (Military Construction) projects and compete for Air Force, Department of Defense (DOD), and Department of Energy (DOE) priorities.

4.3. The 21 SW will make full use of Energy Savings Performance Contracts (ESPCs) Demand Side Management (DSMs) contracts.

4.3.1. Energy Savings Performance Contracts (ESPCs). This is a 25-year contracting vehicle, which allows 3rd party commercial financing of an energy conservation project. Guaranteed energy/utility savings from the existing utility budget pays for the construction. This in simple concepts is similar to a “home mortgage” approach to financing energy projects.

4.3.2. Demand Side Management (DSM) is the local utility company funding of energy conservation projects. Projects are paid through stipulated energy savings from the base or site utility budget or energy rebates from the utility.

C. ROBERT KEHLER, Brigadier General, USAF  
Commander, 21 Space Wing

## Attachment 1

## FACILITY MANAGER'S ENERGY GUIDE

<b>Facility Number:</b>	<b>Date:</b>
<b>Facility Manager:</b>	<b>Duty Phone:</b>
<b>Org/Office Symbol:</b>	

	Yes	No	N/A	Remarks
<b>1. Lighting</b>				
1. Are lights shut off when area is unoccupied?				
2. Are lights shut off when daylight is sufficient?				
3. Are exterior lights shut down in daytime?				
4. Are light levels kept to a minimum in corridor, stairwell, etc.?				
5. Are there areas where lighting in work areas exceeds requirements for task?				
6. Are the lights over partitions, stacks, etc. minimized?				
7. Is there exterior lighting appropriate for the mission?				
<b>2. Computers, Printers, Copiers, Etc.</b>				
1. Are all computers shut off at the end of workday?				
2. Are power management features utilized on all computers?				
3. Are the printers, copiers, etc. shut down or in power saving mode when not in use?				
4. Are personal heaters only used when authorized?				
5. Are vending machine lights off?				
<b>3. Water</b>				
1. Are all water faucet/pipes in facility without leaks?				
2. Is all insulation in visibly good condition?				
3. Are domestic water temperatures at approximately 110 degrees F?				
<b>4. Heating and Cooling</b>				
1. Are unconditioned areas closed off from conditioned areas?				
2. Are air-handling units shut down during unoccupied hours?				
3. Are all air vents cleared of obstructions?				
4. Are exterior doors left closed (including vestibule doors)?				
5. Are all windows left shut?				
6. Are room temperatures less than or equal to 68 degrees F during winter?				
7. Are room temperatures greater than or equal to 75 degrees F during summer?				

	Yes	No	N/A	Remarks
8. Are thermostats free and clear (i.e. not blocked by furniture, etc.)?				
9. Are hot water radiators adequately controlling heat to the space?				
10. Is all insulation in visibly good condition?				
<b>5. Refrigeration and Microwave Units</b>				
1. Are gaskets on doors forming proper seals?				
<b>6. Building</b>				
1. Are the exterior doors aligned properly?				
2. Is the caulking around windows, doors and exterior joints adequate?				
3. Is the weather-stripping around windows and/or doors adequate?				
<b>7. Energy Program</b>				
1. Do your commander and key personnel support the energy program?				
2. Do you work closely with the Facility Maintenance Superintendent?				
3. Are you familiar with the Department of Defense Energy Manager's Handbook located at <a href="http://www.navres.navy.mil/navsurf/dirfacmw/downloads/energy_managers_handbook.pdf">http://www.navres.navy.mil/navsurf/dirfacmw/downloads/energy_managers_handbook.pdf</a> and Building Manager's Handbook located at <a href="http://www.afcesa.af.mil/Publications/ETLs/etl98-4.pdf">http://www.afcesa.af.mil/Publications/ETLs/etl98-4.pdf</a> ?				
4. Are you aware of the current energy efficiency goals?				
5. Do you report all energy deficiencies to your Facility Maintenance Superintendent?				
6. Do you immediately report structural and heating/cooling equipment deficiencies, which directly affect utilities consumption to CE Customer Service?				

## Attachment 2

### FACILITY MAINTENANCE SUPERINTENDENT ENERGY AUDIT GUIDE

This is taken from the DOD Energy Manager's Guide:

#### Energy Audit Guidelines

##### Introduction

The following is intended as a guide to a "fresh caught energy manager" who was just given the challenge to reduce energy consumption on a military installation and who may not have any idea how to start. Some of these steps may seem intuitively obvious, but are still sometimes overlooked by more experienced people looking for more sophisticated problems.

##### Preparation

1. Get a copy of the facility as-built drawings; study the drawings to get familiar with the floor plan and mechanical and electrical systems.
2. Get audit equipment (see Chapter 9 of DOD Energy Manager's Handbook for details):
  - a. Pocket or digital thermometer with a submersible probe.
  - b. Flat head and Phillips screwdrivers.
  - c. Flashlight.
  - d. Stepladder (4 or 6 foot).
  - e. Notepad, pen/pencil.
  - f. Retractable tape measure.
3. Contact facility manager, ask and note the function, days/hours of operation and number of people in the facility. Schedule time to accomplish facility audit; (always include facility manager in initial walk-through.)
4. Get operations and maintenance information to determine the actual level of maintenance performed and the number/type of trouble calls and/or requests for service. For Air Force go to Civil Engineering Production Control Section or the Customer Service Unit. Ask for last 6 to 12 months of data. This will be helpful in spotting problem areas, determining repairs required or the level of retrofit needed. Solicit assistance from operations and maintenance technicians responsible for and knowledgeable in the specific infrastructure systems.

5. Study utility supply and pricing information. Identify all utilities used and compile available data on past use. If no consumption data is available, consider doing short-term monitoring to characterize utility consumption and demand characteristics. Obtain copies of all pertinent rate schedules. Note location of utility metering points and characteristics of distribution system. Talk to utility representatives and get their assistance in studying options available to reduce price, improve reliability, and upgrade infrastructure.

## **Conduct On-Site Audit**

### **Exterior Walk-Around**

Do an outside walk-around of the facility to assess the condition of the building envelope and of exterior lighting:

#### **Building Envelope**

1. Walk around the outside of the facility checking for doors and windows broken or otherwise inoperative. Action: Initiate proper documents to repair or replace.
2. Check exterior doors for door closures, inoperative or missing. Action: initiate proper documents to repair, replace, or install.
3. Check for exterior doors and windows that are propped open. Action: Close, remove props, find out why (this condition is usually an indication that the HVAC and/or controls are broken), repair/replace as necessary.
4. Check for air gaps around doors and windows (1/4 inch or greater). Action: initiate proper documents to repair/replace.

#### **Exterior Lighting**

1. Check for exterior lights that are on during daylight hours. Action: turn off, initiate proper documents to repair/replace, or install sensors/clocks/switches as required for automatic operation.
2. Find out what device controls security lighting: switch, circuit breaker or time clock. If clock, is it operational? Does it show the correct time of day and day of the week? If pin actuated, are they installed properly in order to perform the correct function? Action: repair/replace/calibrate as necessary.

### **Interior Walk-Through**

Do an interior walk-through of the facility to assess how the building is used and zoned, HVAC system types and characteristics, domestic water heating, lighting and other electrical systems, and plug load or other specialized equipment:

## **Building Use and Zoning**

1. Using available drawings, fire plans, or other sketches, draw in the existing walls, doors and windows, if different than shown on the drawings. (Often walls/doors added or removed after original construction will result in poor conditioned air circulation and personnel discomfort; hot/cold temperatures, stagnant air, irritable and/or tired personnel, etc.) Action: get a copy of marked up drawings to CADD personnel for drawing update. Keep a copy; use it for facility upgrade, energy retrofit projects.

## **HVAC Equipment**

1. Locate the HVAC equipment. Note the general appearance and check for obvious problems such as: loose belts, noisy bearings, excessive vibration, dirty filters, water leaking, air leaking, open ducts, oil spots on floor or equipment, pipe insulation missing or in need of repair, unusual noise or equipment short-cycling, damper motor/linkage inoperative or disconnected, pneumatic air compressor/air dryer working correctly (ask your HVAC technicians to show you what to look for and how to do some simple tests; e.g., plugged in, frozen up, correct system pressure, clean/dry air, water/oil in the storage tank, short cycling.) Action: initiate proper documents to have necessary repairs accomplished by appropriate personnel

2. Using the mechanical drawings, draw in the existing location and physical size of all supply, return and exhaust diffusers/registers if different than shown on the plans. Locate and draw in all exhaust fans/systems if not shown on the drawings. Check for proper operation. Action: get a copy of marked up drawings to CADD personnel for drawing update. Keep a copy; use it for facility upgrade, energy retrofit projects.

3. Talk to facility occupants about any hot/cold spots and note on drawings. Action: work with facility manager to relocate desks/work areas, if possible. Initiate proper documents to check heating/cooling/exhaust system, balance air system, make minor modifications to duct system.

4. Check and note control system thermostat/sensor location and look for obvious damage: (missing covers, broken, disfigured, leaking air, etc.) Action: initiate proper documents to have controls repaired/replaced.

5. Check if all energy/utility systems in the facility have EMCS installed. Action: insure EMCS is operational and work with system manager to prepare proper documents for upgrading EMCS as needed to include all energy/utilities systems and functions.

6. Note location, size and number of space heaters found during the walk through. Action: initiate proper documents to check facility central heating system, air balance system, make minor modifications to duct system. Objectives are: customer satisfaction and get rid of space heaters. Keep a copy; use it for facility upgrade, energy retrofit projects.

7. Note location, size and number of window type air conditioners found. Action: initiate proper documents to check facility central cooling system, air balance system, make minor modifications to duct system. Objectives are: customer satisfaction and get rid of individual window type units. Keep a copy; use it for facility upgrade, energy retrofit projects.

## Lighting System

1. Count and note number/type of light fixtures in each room or area. Count and note type of exit signs. Action: initiate proper documents to retrofit facility with energy efficient lighting system. Retrofits can be done separately by facility or included in a multi-facility energy project. In older facilities with significant ballast replacements, retrofit an entire room rather than replace several magnetic ballasts.
2. Note areas that have modular type furniture and task lighting available. Action: initiate proper documents to de-lamp space lighting in favor of task lighting wherever possible.
3. Note any areas where you cannot turn the lights off via a wall switch in the immediate area. Action: initiate proper documents to have switch relocated or installed as needed. (This is a good time to retrofit system with automatic devices, if practical or more economically sound.)
4. Note areas that are equipped with motion sensors or other automatic devices to turn lights off/on. Check with occupants to see if these sensors work properly and if the occupant uses them or overrides. Action: initiate proper documents to calibrate, repair or replace as necessary.

## Other Equipment

1. Note location of vending machines and see if they are internally lit. Action: consolidate/remove machines wherever possible, get vendors to de-lamp machines. (Your installation can save over \$50.00/machine per year simply by de-lamping.)
2. Note concentrated areas of heat producing appliances or other equipment. Action: work with facility manager to disperse equipment, if possible. Initiate proper documents to check heating/cooling/exhaust system, balance air system, make minor modifications to duct system.
3. Note location, number and use status of computers, printers, copiers, etc. Talk with users to see if computers/monitors are on at night. Determine if Energy Star features are activated on computer systems. Action: initiate action to insure that Energy Star features are activated and that non-essential systems are turned off at night.
4. Note location, size and number of coffee dispensers found. Action: educate facility manager on the energy saving benefits of having a centrally located coffee or other beverage dispensing equipment.

## **Water Systems**

1. Check and note the domestic hot water temperature setting and the actual water temperature. (Should be less than 110 degrees F for an office environment.) Action: reset controller; initiate proper documents to have controller re-calibrated or replaced.
2. Locate and check all water systems in and around the facility for leaking pipes, continuous running, dripping faucets/hose bibs/lawn sprinklers. Action: turn off immediately if possible. Initiate proper documents to have necessary repairs accomplished by appropriate personnel.

## **Conduct Follow-Up Analysis**

Based on results of the walk-through audit and resulting awareness, operations and maintenance measures initiated, compile a preliminary list of possible energy/water conservation measures that would require capital investment:

1. Using ideas and strategies from the Handbook, particularly Chapters 4, 9, 10 and 12, as well as the lists below, compile a list of measures that show promise of being cost-effective (i.e., payback of ten years or less, or that have a lower life cycle cost than the “do nothing” alternative).
2. Use rough estimates of project cost and savings to determine if a measure justifies further analysis. Hand calculations, project data from energy managers at other installations, or software tools such as FEDS or ASEAM may be sources of good data. Identify project for further analysis, if simple payback is 10 years or less.
3. For projects that show promise of feasibility and cost-effectiveness, initiate a detailed audit or analysis to provide necessary energy/water cost/savings data for project analysis and justification.
4. Use standard cost estimating guidelines to estimate the upgrade, retrofit, or replacement cost associated with the conservation measure.
5. Conduct life cycle cost analysis of projects to see if they meet criteria for cost-effectiveness. Rank projects that are cost-effective by SIR.
6. Prepare and submit funding requests for cost-effective projects. Where funding is not available, investigate utility programs or ESPC (see Chapter 13 of DOD Energy Manager’s Handbook).

## **Implement Measures**

Implement cost-effective measures and monitor results. As situations change, constantly look for new opportunities to conserve.

**Attachment 3****CIVIL ENGINEERING O&M/ECM ENERGY CONSERVATION GUIDE  
ENERGY CONSERVATION MEASURE IDEA LIST**

Use the following lists to help generate ideas for possible energy conservation measures. Review the four fundamental ways to reduce energy/water cost (see Chapter 10 of DoD Energy Manager's Handbook) to help keep things simple. Lists are organized by system type or major energy end use area and categorized in two major categories:

1. Operations and Maintenance (O&M), no- or low-cost measures comprising awareness, operations, and maintenance measures (see discussion in Chapter 4 of DoD Energy Manager's Handbook).
2. Energy Conservation Measures (ECMs), measures requiring capital investment, comprising replacement, retrofit, or upgrade projects.

**Building Envelope****O&M**

Seal cracks with caulking or other materials.

Repair, replace or install weather-stripping on windows and doors.

Replace broken glass.

Repair doors and windows so they operate properly.

Adjust, replace, or install automatic door closers.

Seal vertical shafts and stairways.

## **ECM**

- Install additional insulation.
- Install storm windows.
- Install new windows.
- Block up unneeded windows or other openings.
- Install plastic strip curtains or air curtains on service doors.
- Install vestibule or revolving door on high traffic entrances.
- Reduce solar gain:
  - Install window film.
  - Install interior shading such as blinds or curtains.
  - Install exterior shading such awnings or landscaping.
  - Install reflective roof surfaces.
  - Paint exterior surfaces light colors to reduce solar heat gain.

## **HVAC System**

### **O&M**

- Lower heating thermostats to 68-70 deg F.
- Raise cooling thermostat to 75-78 deg F.
- Turn off heating and cooling in unoccupied areas.
- Set heating and cooling timers to minimum run times.
- Insure time clock pins are installed and set properly.
- Eliminate use of portable electric heaters.
- Follow manufacturers' recommended periodic maintenance procedures.
- Clean evaporator and condenser coils on packaged equipment.
- Clean chiller evaporator and condenser surfaces of fouling.
- Replace air filters.
- Clean fans.
- Clean ductwork.
- Repair duct leaks.
- Clean air diffusers and registers.

Clean convection units/radiators.

Turn off gas pilots except during heating season.

Eliminate use of boilers for hot standby during mild weather.

Balance HVAC system for proper operation and comfort, and to minimize reheats.

Reduce ventilation rates to ASHRAE recommended values for IAQ.

Use outside air for cooling when appropriate.

Reset supply air temperatures.

Reset hot/chilled water temperatures.

Repair hot/chilled water or steam piping leaks.

Replace/repair hot/chilled pipe insulation.

Replace leaking or blowing steam traps.

Insure refrigerant systems are properly charged.

Test and adjust boiler.

Clean boiler surfaces of fouling.

Check flue for improper draft.

Check for air leaks in boiler or furnace.

## **ECM**

Install programmable thermostat.

Install time clocks.

Install EMCS to control HVAC.

Install outside-air economizer with enthalpy controller.

Install evaporative cooling system.

Install desiccant cooling system.

Install cooling tower cooling system.

Install roof-spray cooling system.

Create air movement with fans.

Exhaust hot air from attics.

Replace HVAC packaged equipment with high-efficiency equipment.

Convert constant volume systems to variable air volume.

Install automatic boiler controls.

- Install flue gas analyzers for boilers.
- Preheat combustion air, feed water, or fuel oil with reclaimed waste heat.
- Install air-to-air heat exchangers.
- Install heat pump water heaters.
- Install ground-coupled heat pump.
- Isolate off-line chillers and cooling towers.
- Isolate off-line boilers.
- Install automatic boiler blow-down control.
- Install pulse or condensing boilers/furnaces.
- Install evaporative-cooled or water-cooled condensers.

### **Lighting Systems**

#### **O&M**

- Clean and maintain fixtures.
- Remove unneeded lamps or fixtures.
- Turn off lights in unoccupied areas.
- De-lamp vending machines.
- Turn off lights near windows or skylights.
- Use partial lighting when building is not fully occupied.
- Re-schedule or reduce nighttime activities to reduce lighting operation.
- Reduce illumination levels to IES recommended values.
- Use only necessary safety and security lighting.
- Insure automatic controls are working properly.

#### **ECM**

- Install new lighting controls where needed.
- Install automatic controls or occupancy sensors.
- Replace incandescent lighting with compact fluorescent or other high-efficiency sources.
- Replace standard fluorescent lighting with electronic ballasts/T-8 fluorescent.

Replace existing lighting with higher efficiency source.

Install high-pressure sodium lighting where color is not critical.

Replace mercury vapor lighting with high-pressure sodium.

Use task lighting to reduce general illumination requirements.

Install reduced output electronic ballasts where necessary to match illumination levels with IES values.

Replace incandescent and compact fluorescent exit signs with LED exit signs.

Install dimming controls or light level occupancy sensors where windows and skylights are providing day lighting.

## **Electric Power Systems**

### **O&M**

Check and adjust connections in electric distribution systems.

Disconnect or switch off unused transformers.

Adjust drive belts of electric motor systems.

### **ECM**

Correct power factor.

Install energy-efficient transformers.

Install energy-efficient motors.

Replace oversized motors with properly sized motors.

Install variable speed drives.

Install power factor controller on low load, constant-speed applications.

Use load shedding to reduce peak demand.

Use emergency standby generators to reduce peak demand.

Install a cogeneration system.

Install a thermal storage system to reduce peak demand.

## **Water Systems**

### **O&M**

Reduce hot water temperatures.

Repair dripping or leaking fixtures.

Locate and repair water distribution system leaks.

Plan irrigation to minimize evaporation, typically early morning.

Use low water plantings and drip irrigation.

Adjust valves for minimal water use.

Wash only full loads (laundry and dishwashing).

### **ECM**

Insulate hot water pipes and storage tanks.

Install time or demand controls on hot water re-circulation systems.

Install point of use water heaters to eliminate re-circulation.

Install heat pump water heaters in kitchens and laundries.

Install solar water heating system.

Install efficient low-flow shower and faucet fixtures.

Install efficient toilets and urinals.

Install water-efficient laundry and dishwashing appliances.

Redesign landscaping to use xeriscape principles.